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22OCT98 E399153-1 D00100
P01/7700 0.00 - 9823062.6

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Cardiff Road
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1. Your reference — ACR/SH-57542

2. Patent application number *(The Patent Office will fill in this part)* — 21 OCT 1998 — **9823062.6**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

John Francis DUFORT
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PL27 6AF

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

7525592001 DS

4. Title of the invention — PLASTICS ARTICLE AND METHOD OF MANUFACTURE

5. Name of your agent *(if you have one)* — LLOYD WISE, TREGEAR & CO

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

COMMONWEALTH HOUSE
1-19 NEW OXFORD STREET
LONDON WC1A 1LW

Patents ADP number *(if you know it)* — AL002

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

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a) any applicant named in part 3 is not an inventor, or
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Description	10
Claim(s)	
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
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11. I/We request the grant of a patent on the basis of this application

Signature [signature] Date 21 October 1998

12. Name and daytime telephone number of person to contact in the United Kingdom

STEVEN HOWE
0171 571 6200

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PLASTICS ARTICLE AND METHOD OF MANUFACTURE

In the late nineteenth and early twentieth centuries, lithophanes were formed from porcelain. These objects were pieces of porcelain which were formed with sections of various thickness corresponding to the light and dark parts of an image, with the darker sections formed as thicker portions of the porcelain and lighter sections formed as thinner sections of the porcelain. The porcelain was fired at a very high temperature, resulting in the porcelain becoming translucent. By shining light through the porcelain from behind, as a result of the different thicknesses of the porcelain and therefore the different transmissivity of light through the porcelain, the image is seen, with the different intensities of light passing through the porcelain corresponding to the different areas of light and shade of the original image.

In the early part of the twentieth century, lithophanes were formed by engraving a mould from wax with the relief of the mould corresponding to the areas of different brightness of the desired image, and these were used to mould ceramic to form the lithophane. Such lithophanes were used as window hangings, fire screens, teapot warmers and lamps.

From around the 1930's, there was no longer any interest in lithophanes, and they are rarely seen today.

The present invention relates to a plastics article having different thicknesses corresponding to the different intensities of an image, and to a method of forming such a plastics article, the resulting article having a similar appearance to a porcelain lithophane.

According to a first aspect of the present invention, a method of forming a plastics article comprises the steps of:

determining the relative intensity at different points of an image;

machining a mould to give a relief corresponding to the relative intensity of the points of the original image; and,

moulding the plastics article from a translucent material in the mould to form a plastics article having different thicknesses corresponding to the different intensities of the original image.

It has been found that an article giving a similar visual appearance to a lithophane formed from porcelain can be formed from a plastics material. Such an article is advantageous over a porcelain lithophane in that it is significantly cheaper and easier to manufacture, does not require firing at a high temperature and is less susceptible to damage. Further, by selection of a suitable plastics material, it is possible to see the image when the article is back lit by natural light, rather than requiring a bright light source. By moulding the article, for example by injection moulding techniques, mass reproduction is possible.

It is preferred that the determination of the relative intensity of the different points of the image is achieved by scanning the image, for example into a computer.

Preferably the step of forming the mould is carried out by a high speed three axis numerically controlled engraving machine. This can be loaded with the relative intensity values of the desired mould, and

can cut any desired number of moulds. If a non-flat article is to be produced, a four or five axis numerically controlled engraving machine may be needed. Alternatively, the mould may be formed by a laser cutting machine, or by spark-erosion.

The mould is preferably formed from metal which is able to withstand the high temperature of the molten plastics material from which the article is to be formed, and which has a long life to allow for repeated mouldings.

It is preferred that a number of moulds are formed from a single mould block to allow a large number of articles to be moulded simultaneously.

In an alternative aspect of the present invention, a plastics article can be formed by determining the relative intensity at different points of an image, and machining the plastics article from a translucent plastics material so that the plastics article has a relief such that the thickness corresponds to the different intensities of the image.

This method of forming plastics articles does not allow for the same economy of scale and mass reproduction associated with the first aspect, but is able to produce limited quantities of articles having a specific design. For example, a person's image can be obtained from a digital camera or from a scanned photograph, and machined into a plastics article. This will be difficult to replicate, and so can be used as a security or identification device.

According to a further example of the present application, there is provided a plastics article having different thicknesses at different positions

corresponding to the relative intensity of an image, in which the plastics article transmits or emits light with an intensity corresponding to the thickness of the material.

The material from which the plastics articles are formed should be transparent or translucent, for example may be polystyrene, polypropylene, styrolux, clear ABS or acrylic. The plastics material is preferably filled with a suitable filler material such as china clay, chalk or other filter to give the desired effect.

The plastics material may include luminescent particles or may be coated on the back by a luminescent layer. In this case, the luminescent particles can emit light, and it may therefore be possible to view the image without light being shone through the article. Where luminescent particles are included, the lighter parts of the image may correspond to the thicker parts of the article and the darker parts to the thinner parts as, in this case, in the thicker regions there will be a greater amount of luminous particles and therefore there will be a brighter section.

The article may be coloured. In this case, the article may be coloured with a single colour to give an overall tint, or there may be different colours at different parts of the article to give parts of different colour.

Where the colour is a single colour, this may be achieved by including pigment in the plastics material used for the moulding. Alternatively, a coloured layer may be formed on a surface of the article. One surface of the article, for example the rear surface, will

usually be planar, and therefore a coloured layer can be formed on this surface easily, for example by transfer or sublimation printing or by an ink jet or silk screen printing technique. This will acts as a filter to the light passing through the article.

The article may be formed from heat sensitive material. In this case, the image may only be seen when the article is heated. For example, if the article is formed into a lamp shade, it may be heated by the lamp to become translucent.

The plastics article according to the present invention can be used for a number of purposes, including character promotions, key rings, inserts to be provided in cereal packets, light shades, plates, cups, pictures etc. By use of suitable processing techniques, the article may be a non-flat or three-dimensional article. It is also possible to produce a stereoscopic image by having two side by side articles having substantially the same image but from a slightly different perspective, each of the images being viewed by a different one of the viewer's eyes.

In an alternative example, both surfaces of the article include relief. In this case, the overall thickness of the plastics material at any point corresponds to the relative intensity of the image at that point, however the article is recessed on both sided. This gives an article which can be viewed from either side. Where the article includes one flat surface and the relief is provided exclusively in the other surface, the image can only be viewed properly from the relieved side of the article. Preferably the article is recessed on both sides to a corresponding amount. This eases the manufacture of the article. For example, where

the article is formed in a mould, the two parts of the mould may be engraved as a mirror image of each other.

In this case, the article may be formed as a single piece, or may be formed in two parts which are fixed back-to-back. Where the article is formed in two parts and these are fixed back-to-back, such fixing may be by means of an adhesive, or may be by a mechanical interconnection or clamp. Where the article is formed in two parts, it is possible to provide a coloured or luminescent layer between the two parts before these are assembled together to give the desired colour filter or radiation of light as required.

Examples of the present invention will be described in accordance with the accompanying drawings, in which :

Figure 1 shows a schematic view of the system for forming the plastics article;

Figure 2 shows a cross-section through a mould for forming a plastics article; and,

Figure 3 shows a cross-section through an alternative example of a plastics article.

As shown in Figure 1, an image 1, for example a photograph or painting, is scanned by a scanner 2 to convert the image 1 into electronic data which corresponds to the image 1. The data corresponding to the scanned image is input to a processor 3. Alternatively, the image may be generated initially in electronic form, for example using a graphics package, or may be loaded from a store of pre-converted or generated images, for example from a CD-ROM, or downloaded, for example from the Internet.

The processor 3 analyses the data corresponding to the image to determine the relative intensity, i.e. the relative darkness or lightness, at different points or pixels of the image. This intensity information is provided to a numerically controlled milling machine which is able to use the intensity data to machine one half 11 of a mould in which the depth of the mould at different positions corresponds to the relative intensities of the original image. In a preferred example, the mould has a greater depth where the corresponding position of the original image has a low intensity (i.e. where the image is dark), and has a shallower depth where the corresponding position of the original image has a high density (i.e. where the image is light).

The machined mould half 11 and an associated mould half 10 having a generally flat surface, are placed together to form a mould cavity, and plastics material is injected into the mould cavity. The plastics material may be acrylic polystyrene, polypropylene, styrolux, or clear ABS. To make the plastics material translucent, a filler material such as china clay, chalk or other filter material is added to the plastics before this is injected into the mould cavity.

When the plastics material has set, it is removed from the mould. The resulting article will be translucent, and will have a greater thickness in those areas corresponding to darker areas of the original image than the areas corresponding to the lighter areas of the original image. When light is shone through the article from behind, the light is transmitted through the thinner parts of the article more easily than through the thicker parts of the article, and therefore the thinner areas appear lighter than the thicker areas. This corresponds

generally to the light and dark areas of the original image, and therefore an image corresponding to the original image can be seen.

The article may be coloured on the back by any suitable printing technique, for example by ink jet printing. In this case, the colour is easy to apply as it is applied to the flat rear surface of the article. The coloured layer on the back of the article acts as a colour filter which only lets light of selected wavelengths pass through the layer and hence through the translucent article, and therefore the light viewed through the article is of certain colours. Where the rear of the article is coloured substantially entirely with a single colour, the whole image viewed through the article will have a colour tint, however it is preferred that the rear of the article is selectively coloured with areas of different colour. This allows the light transmitted through different parts of the article to be of different colours, which may correspond to the colours of the original image.

Alternatively, a coloured pigment may be added to the plastics material before this is injected into the mould. In this case, the pigment within the plastics material will act as a filter to allow only light of certain wavelengths to be transmitted to form the view image.

It is also possible to add a luminescent pigment to the plastics material used to injection mould the article. In this case, it is not necessary for a separate back light to be used to view the article, since the article will itself emit light. In this case, the mould is made in reverse to that described above, with the areas corresponding to the lighter sections of the

image being formed more deeply than the areas corresponding to the darker areas. In this case, the plastics article moulded by the mould will be thicker in those areas corresponding to lighter areas of the original image, and therefore will have a greater amount of luminescent pigment, and therefore will emit more light than the thinner areas corresponding to the darker regions of the original image which will have less luminescent material and therefore will emit less light.

An alternative example of an article according to the present invention is shown in cross-section in Figure 3. In this example, rather than the article being formed with a flat rear surface and a front surface having a relief corresponding to the relative intensity of the different parts of the image, the article is formed with a corresponding relief on both faces. This can be achieved either by forming the two mould halves with a corresponding, mirror image, relief, the relief in each part corresponding to half the required relief for the desired overall thickness of the finished product, or by engraving with a CNC machine. Alternatively, as shown in the example of Figure 3, the article can be formed in two parts, each part having one flat face and one face with relief, each part made in accordance with any of the methods described herein. In this case, the two parts of the article are fixed together in back-to-back relation. Due to the variation in thickness of the complete article, there will be a similar transmission of light as with a single article having a flat rear face. However, it is possible to view the image through the article from either side, whereas when one face is flat, it is difficult to view the image from this flat face.

As shown in Figure 3, a coloured layer is printed on the flat face of one part of the article. In the complete article, this layer is sandwiched between

the two parts of the article and therefore is not susceptible to damage, for example by wear or scratching. The coloured layer may alternatively or additionally be a luminous layer, in which case it may not be necessary to hold the article to a light source when the image is viewed. The two parts of the article are then joined by a suitable adhesive.

As with the first example, it is possible to provide a coloured or luminescent layer on one face of the article, or to make the article of a plastics material including coloured or luminescent particles.

The injection moulded articles according to the present invention, which, due to the method of manufacture can be formed inexpensively and in large numbers, can be used in many different applications, for example, but not limited to, character promotions, key rings, inserts to be provided in cereal packets, light shades, plates, cups, and pictures.

It may also be possible to form a plastics article having variable thickness or contour corresponding to the relative intensity of an original image by engraving the article directly, for example using a CNC machine, in the same way as described above for forming the mould. In this case, it would be simple to make one-off items, for example it would be possible to convert an image of a person's face into data relating to the relative intensity of the image, and directly engrave a plastics article with different thickness regions corresponding to the different intensities of the image of the person's face. This could be used as a security device, for example as an identification card, which would be very difficult to forge.

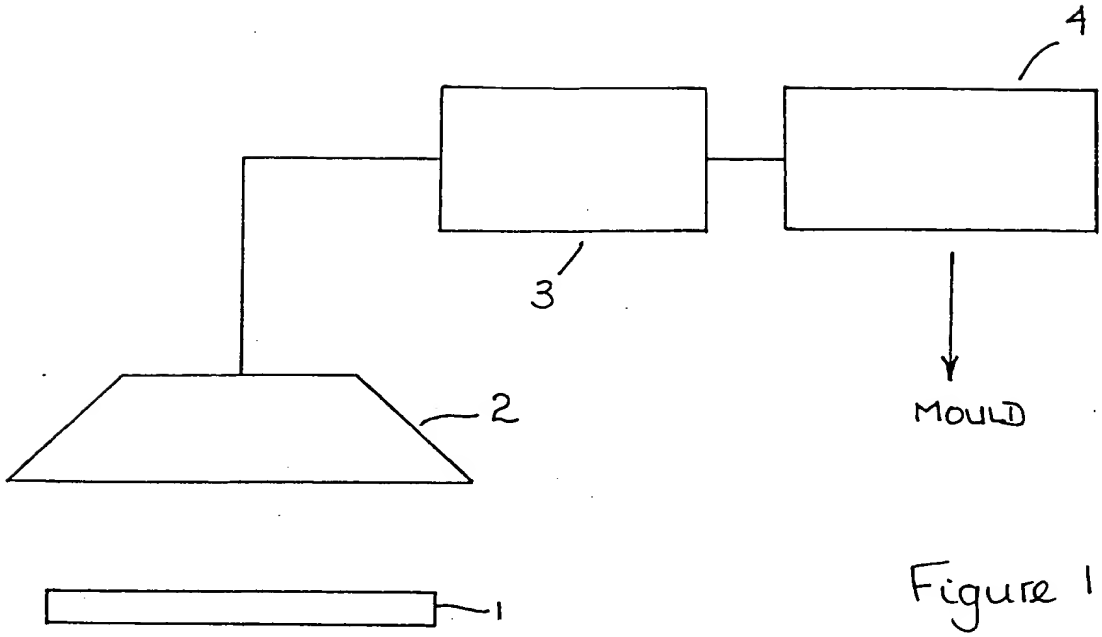

Figure 1

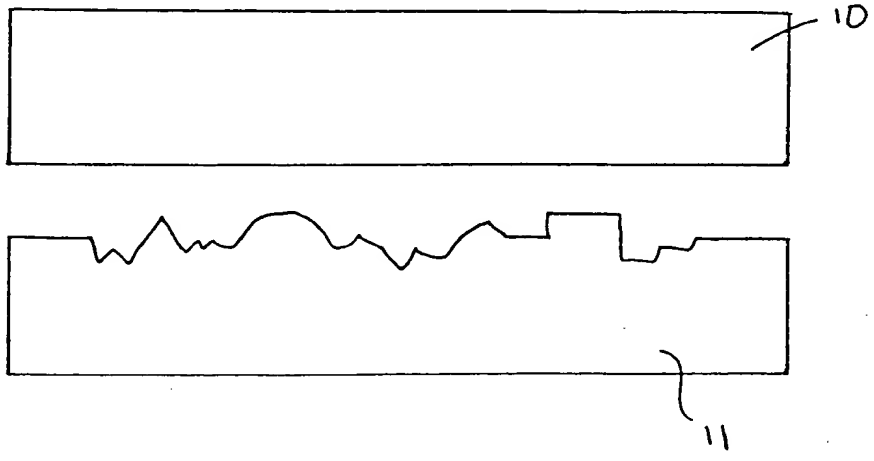

Figure 2

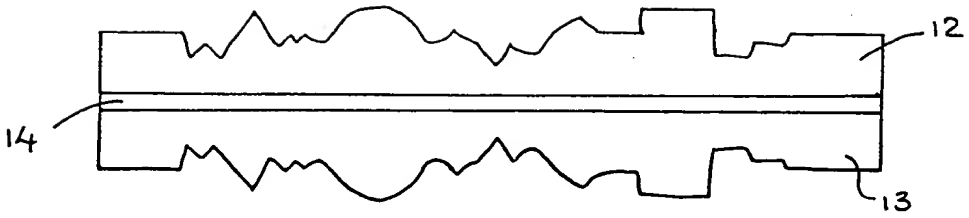

Figure 3

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